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INTERFACIAL FRICTION BEHAVIOUR IN NARROW WALL PASTE BACKFILL SYSTEM

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Abstract

Understanding on the effects of interfacial friction within narrow wall is important in the design of underground stope backfill system. Laboratory scale stope model made of metal such as aluminium is normally used to simulate the actual stope paste backfill system, however, verification of such system in terms of interfacial friction behaviour is lacking. This paper presents the experimental results on the interfacial friction between backfill material and the aluminium narrow wall system as well as the internal friction of the paste backfill. Standard and modified direct shear tests are employed to investigate such behaviours under dry and saturated conditions for uncemented paste backfill (UCPB) and cemented paste backfill (CPB). For the CPB, cast in-situ and precast is also compared. The shear stress-strain behaviour is showcased in detail for every test. The general findings show that the interfacial friction angle (δ) at the backfill-aluminium interface is weaker than internal friction angle (ϕ) of the backfill itself with an average factor of 0.69 (δ/ϕ =0.69). This factor is comparable to 2/3 or 0.67 which is commonly used in the design and analyses. The results help to better understand the behaviour of the backfill system, enabling engineers to optimize the paste backfill system design.

Keywords: *Shear strength, Stress-strain, Interfacial shear, Narrow wall, Arching*

INTRODUCTION

The growing demand on mining products to improve and sustain human civilization had increase the numbers of mining activities around the world (Sheshpari, 2015). Mining is an activity to seek and extract profitable minerals embedded within the Earth's crust (Yilmaz et al., 2003). Due to the scarcity of minerals around the ground level, deep mining is the next challenge for the mining companies to maintain their profit margin (Nasir & Fall, 2008; Sheshpari, 2015). Underground ore extraction will create mined-out spaces (stopes) in forms of narrow rectangle with plan dimensions of 15–40m and heights of 50–100m and above (Helinski et al., 2007; Rankine & Sivakugan, 2007) that could reduce the ground stability and indirectly giving impact to ore recovery rate and safety issues (Ghirian & Fall, 2015). Mining activities result in huge quantities of waste rock stockpiling and tailings impoundments (Li & Yang, 2015).

Mine backfill is a new tailings management technique that utilise dewatered slurries as uncemented paste backfill (UCPB) or cemented paste backfill (CPB) to fill-up stopes for underground general stability (Benzaazoua et al., 2004). The cemented paste backfill (CPB) is widely adopted in underground mining industry around the world due to its technical, environmental and economical strongpoints (Belem et al., 2002; Yilmaz et al., 2003; Benzaazoua et al., 2004; Fall et al., 2008; Li & Yang, 2015). CPB utilizes dewatered tailing waste, binding agent and water to create a free-flowing slurry-paste form to be filled into stopes and hardened as adjacent underground mine support (Helinski et al., 2007; Fall et al., 2008; Ghirian & Fall, 2015; Sheshpari, 2015). CPB mix proportion is usually in between of 3–7% by weight for binder and 70–85% by solid for tailings (Landriault, 1995; Orejarena &